An Optimized Performance Analysis of Closed Loop Supply Chain of Third Party Logistics based on Analytic Hierarchy Process

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Abstract

The emergence of closed loop supply chain provides new ideas for enterprises to solve environmental problems. In this paper, the author makes an optimized performance analysis of closed loop supply chain of third party logistics based on analytic hierarchy process. Closed loop supply chain management is the management of the whole life cycle of products. Through the recycling of products, it greatly reduces the consumption of resources and the waste emissions of waste products, thus improving the environmental performance of enterprises. The empirical analysis finds out the factors that affect the performance of enterprise supply chain, and provides a scientific index system for the performance evaluation of the third party logistics enterprises.

Keywords: Closed loop supply chain, Analytic hierarchy process, Empirical analysis, Third party logistics

1. INTRODUCTION

In the economic globalization today, the parallel chain theory cannot effectively reflect and support the operation of the modern supply chain of traditional, some inherent defects of the chain structure so that it is no longer suitable for today's open, flexible and economic environment, and should consider the establishment of new flow structure theory. More and more attention has been paid to reverse commodity flow, which has been returned at the end of the normal life cycle. Many companies have found that these used goods are also valuable resources. Recycling, including remanufacturing, recycling, recycling within a certain range, makes the enterprise gain more benefits, or the value of raw materials, and even increase revenue. At first, researchers focused on understanding the special logistics demand of upstream goods flow. At the same time, the division of forward and reverse commodity flow provided more development space for the collection of related internal flow and external flow, which is called closed loop supply chain

Although the third party logistics industry in our country is very rapid development, but due to the relatively backward, so it is not perfect and standard. According to the research on the logistics market demand and operation results in our country, now stage of China's third party logistics enterprise service level is relatively low, the customer satisfaction degree is not high; resulting in development level is still relatively backward (Selviaridis, 2007; Ren, 2013). How to change this predicament, become an urgent problem to be solved. So if the third party logistics enterprises can as soon as possible to find the existence of their own problems in a timely manner to compensate its shortcomings, a comprehensive analysis of the problem the crux of the problem, as soon as possible in order to catch up with western developed countries, the level of logistics operation, each link of the supply chain for better control. Based on the third party logistics enterprise performance evaluation can enable enterprises to beforehand control and guidance on its performance and efficiency, ex post assessment and measurement, judge whether the completion of the scheduled tasks, due to the effectiveness (Seth, 2006). The rapid development of the third party logistics today, the establishment of a system, perfect performance evaluation system, the third party logistics enterprises to carry out accurate and objective evaluation, it is becoming more and more important. After China joins WTO, the third party logistics enterprises in the promotion of this kind of open, free and all kinds of preferential policies, soon grow into a very large and representative industry. Therefore, how to combine the characteristics of the third party logistics enterprises and the current situation, to establish a more realistic, more perfect and reasonable performance evaluation system of the third party logistics enterprises, it is particularly important.

(1) To improve the management level and efficiency of the third party logistics enterprises. The cost of China's third party logistics is much higher than western developed countries, the level of logistics management is low, the efficiency is not high, so the reduction of logistics cost in China has a lot of room for improvement. To this end, China's logistics enterprises should optimize enterprise management capabilities as a starting point, the establishment of a performance evaluation system suitable for their own development, optimize management capabilities, improve the quality of management.

(2) To enhance the core competitiveness of the third party logistics enterprises. Compared with western developed countries, China's third party logistics enterprises started relatively late, there are a lot of defects, the system, the mechanism is still not complete, still in the initial stage of development. Therefore, pay attention to the performance evaluation and analysis of the third party logistics enterprises, will be able to help them

improve the core competitiveness of enterprises, so as to create a favorable environment for the development of enterprises.

(3) To establish a good brand image of the third party logistics enterprises. The third party logistics enterprise how to for the customer provide satisfactory products and services and how to concentrate its brand image in the service quality of the enterprise, service enterprises how to get customer approval has become issues of common concern to the industry. Therefore, the results of the third party logistics enterprise performance evaluation for the establishment of corporate brand image, to create intangible assets to provide reference and assurance.

2. LOGISTICS PERFORMANCE EVALUATION

2.1. Third party logistics enterprises

The concept of the third party logistics (Logistics Third-party) originated from the management of Out-sourcing. Out-sourcing refers to the company according to the change of the external environment and their own conditions, and external supply chain all the key nodes on the enterprise features, using its own internal resources and external resources for other enterprises to provide professional logistics services, so that other companies to focus on the development of its core competitiveness. Third party logistics has become a new trend in the field of logistics, and gradually grow and develop. China's third party logistics started late, in many aspects is not perfect, so far there is no clear definition of the third party logistics, but has been more and more attention. Logistics activities include all kinds of activities in order to meet customer needs and carry out the planning, implementation and control of goods, services and information from the initial location to reach the destination. Third-party logistics refers to by the third party logistics service provider, demander to complete the operational mode of logistics service. Different from the traditional enterprise management mode and the third party Logistics Company must according to the logistics demand, customer needs to provide a variety of logistics activities, including transportation, storage, loading and unloading, handling, packaging, distribution processing, distribution and information processing.

Figure 1. Logistics system framework

Third party logistics refers to the supply side and the demand side of the two objects, and the establishment of a bridge between the two specialized organizations, professional supply and demand side and demand side to provide logistics services. Logistics enterprises in each link of the whole supply chain operation, does not participate in the production, management and other core business, but plays a connecting role, through the logistics activities, connecting every node of the supply chain, make between nodes, very smooth connection, and save its energy and to improve their core competence. The third party logistics for each node enterprise provide very professional logistics services, and make the management more standardized, so as to provide more humanization, diversification of service and the various supply chain nodes better convergence, for the society create greater value. Warehousing, transportation industry after years of development, gradually found its own direction of development, and gradually transformed into an important part of the third party logistics. The experts and scholars of the western developed countries to the third party logistics under a more unified definition: the third party logistics is refers to each node in the supply chain enterprises before each responsible for its logistics activities, but now by other organizations or institutions to outside of self to their service, which is a professional logistics service for manufacturers, suppliers, distributors, etc.. And manufacturers, suppliers, dealers themselves no longer perform their own logistics activities, completely outsourced. The third party

logistics, as an advanced form of logistics service, has gradually formed its own remarkable characteristics in the development.
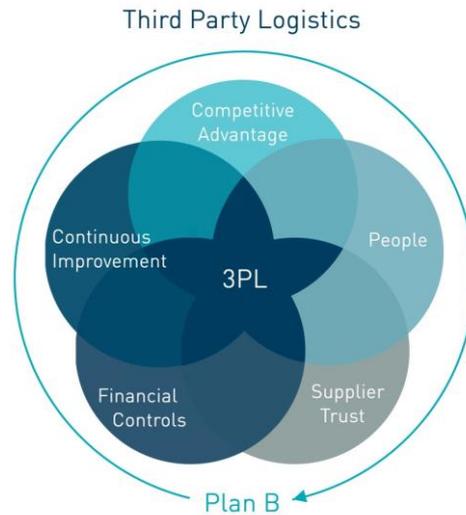

Figure 2. Third party logistics

(1) The cooperation between the third party logistics enterprises and the various nodes in the supply chain is a long-term, strategic and close relationship. So the third party logistics enterprises should pay more attention to their own development ability, and constantly expand their business, in order to better convergence of the supply chain is the object of service.

(2) The third party logistics enterprise alliance cooperation approach. The third party logistics and the owner of the business through cooperation formed long-term strategic cooperative relations. Therefore, "complementary advantages, benefit sharing" has become a symbiotic relationship between each other. At this time of the third party logistics enterprise is not to provide temporary logistics services, or to achieve one or several independent simple logistics functions. So, the owner of the enterprise must be to find a long-term strategic partner, by the strength of the alliance to obtain competitive advantage, to form very important strategic alliances.

(3) The logistics service provided by third party logistics enterprises is based on modern information technology. Therefore, the third party logistics enterprise service is more and more relying on modern information technology. The development of information technology has shortened the distance between logistics enterprises and customers, so that they can communicate at any time, through the information system, as soon as possible to submit orders, communication and logistics circulation operation process. Using the existing advanced information technology to shorten the logistics cost, speed up the corresponding speed, so as to improve the operational performance of the third party logistics enterprise.

(4) Third party logistics enterprises to provide personalized logistics services. Customer differences determine the existence of different logistics service needs. Therefore, the third party logistics need according to different customers in the corporate image, product characteristics, competition, business processes, customer demand characteristics of different needs, provide for personalized, high-quality logistics services and value-added services, thereby enhancing the competition ability of the third-party logistics market.

(5) Third party logistics enterprises to provide contract oriented multi series services. Third party logistics is different from the traditional logistics enterprises, traditional enterprises are limited to one or some scattered logistics functions, such as transport services, such as the company's transport services, etc.. Although the third party logistics also includes individual services, but more in accordance with the contract terms of the agreement, the integration of one or more of the logistics function, providing a full range of logistics services. Generally, the third party logistics enterprises can provide warehousing, transportation, after-sales service, product recycling, order processing, customs and other logistics services.

2.2. Logistics performance evaluation

Third party logistics enterprise performance evaluation refers to the evaluation by the results of the third party logistics enterprise, efficiency, profit and loss, and so on each link, the evaluation can be qualitative, quantitative, can also be a combination of qualitative and quantitative. The third party logistics enterprise can according to the results of the evaluation of enterprise's own existence problem analysis, timely modify their own development goals. To manage various aspects of the process of effective control, enable enterprises so as

not to pay a heavy price to begin to deal with the problem, have a certain degree of predictability. With the advanced information technology, timely communication of information, transfer and feedback, enterprise dynamic adjustment of target, process, making each link can be operated according to the evaluation results. Third party logistics enterprises should attach great importance to their own performance evaluation. In time for their own operation, management, implementation of the various aspects of control, and according to the evaluation results to establish the corresponding development and improve the mechanism, the establishment of incentive system, so that it has a more rapid development.

(1) Supervise the operation of the third party logistics enterprises. For managers, the hope that the time to master the earnings of the business operations, then how to make a very timely understanding of this situation, is the most concerned about the management of the place. Managers can according to the third party logistics enterprise performance evaluation results on the operation of enterprises of various indicators for the overall control, if there are problems, timely adjust business plans and development goals, to enterprise's operation of the link of supervision and control.

(2) To control the operation of the third party logistics enterprises. Mainly refers to the activities in the process of evaluation, control. This timely control, can make the management of major losses in the event of a major loss to correct the error, improve the logistics process, which is about to deviate from its normal state when it is on the right track.

(3) The results of the performance evaluation of the third party logistics have been greatly inspired by the staff. For example, if you are paid by performance, you can motivate the warehouse staff and the transport personnel to achieve the higher productivity as much as possible. However, pay attention to the evaluation, not only to evaluate productivity, but also to evaluate the quality of work.

Figure 3. Supply chain management

2.3.Closed loop supply chain of third party logistics

On the closed-loop supply chain management, enterprises there are two different views of most enterprises believe that the implementation of the closed-loop supply chain management will increase the operating costs of additional cost recovery, enterprise re processing costs, testing costs, focus on the problem of waste products, will certainly affect the smooth development of the main business, LED to a sharp decline in corporate profits. But a few companies that closed-loop supply chain management can bring new economic opportunities for the enterprises, in their view, based on the life cycle management of products, not only can make the product to obtain the greatest degree turn, can also reduce the purchasing cost, reduce energy consumption, build a strong environmental performance advantage, so as to bring more benefits to the enterprise.

Compared with the traditional supply chain, in the closed-loop supply chain based on the third party logistics, the customer has become the focus of the supply chain alliance, customer satisfaction is the basis of each node enterprise in the supply chain. Customers are not satisfied with the goods will pass through the reverse supply chain recovery, the recovery of goods according to their specific circumstances, according to the damage and reuse of re entering the supply chain, the intact or just damaged packaging products after repackaging and sales, while those parts have problems after renovation and remanufacture back into the market, or is the recovery of useful raw materials, parts, those who cannot use also for disposal. The whole process has

realized the cost optimization, the benefit maximization, simultaneously also has manifested the green, the environmental protection.
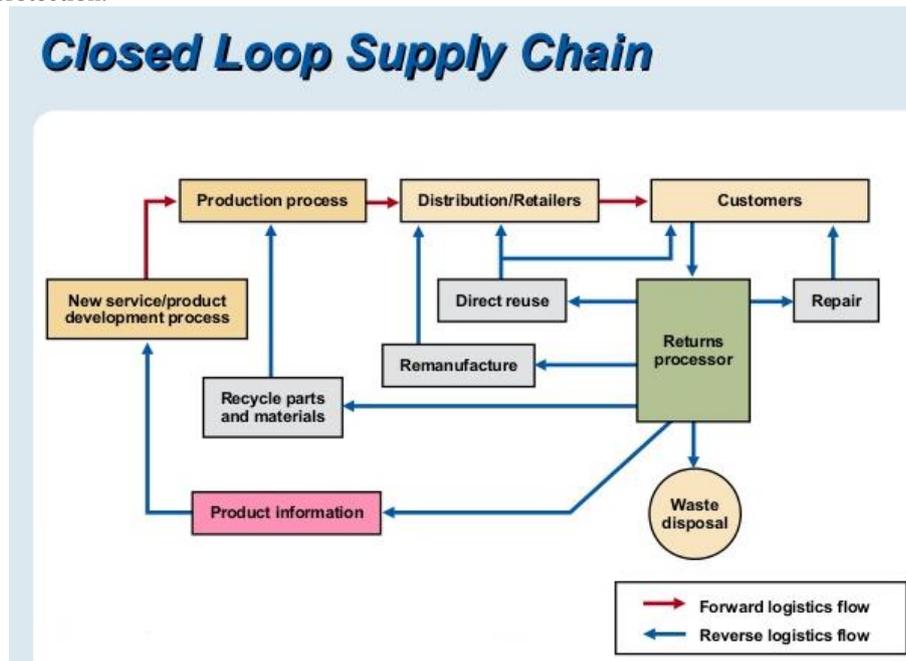

Figure 4. Closed loop supply chain

3. EMPIRICAL ANALYSIS

3.1. Evaluation index system

According to the research of the third party logistics theory, it is necessary to establish a kind of evaluation method, which makes the evaluation result more reasonable, scientific and accurate. Third party logistics enterprises can accord the evaluation results, the development of their own to make appropriate adjustments. In order to make the evaluation result more accurate, we should establish the principle that should be followed in the evaluation system of the third party logistics enterprise.

(1) Each index in the evaluation system should follow the principle of comparability. The spatial and temporal range of evaluation index system and the method of calculating caliber and economic content should be comparable. Therefore, the establishment of evaluation index system should refer to the international and domestic logistics management standards.

(2) In the evaluation system of the various indicators should follow the principle of universal. Evaluation index system should be widely applied in the third party logistics enterprises, and it should have the relative stability in the development of theory and practice.

(3) Each index in the evaluation system should follow the principle of hierarchy. Each indicator should be divided into evaluation levels, in each level of the indicators selected to highlight the key, and the key performance indicators to focus on analysis.

(4) In the evaluation system of the various indicators should follow the principle of systematic. Enterprises should design the corresponding evaluation index based on the situations inside and outside of the third party logistics enterprises, systematically, scientifically and comprehensively reflect the panorama of the third party logistics enterprise to on the third party logistics enterprise overall and scientific evaluation.

(5) The third party logistics enterprise performance evaluation method should follow the principle of quantitative and qualitative combination. In the selection of indicators should be based on quantitative indicators, can be used as far as possible to use a quantitative method of quantitative calculation method; cannot use quantitative methods or not suitable for quantitative methods, the use of qualitative analysis.

(6) In the evaluation system of the various indicators should follow the principle of dynamic long-term. Because of the choice of the third party logistics enterprises, between the supply and demand side and the third party logistics provider will establish good strategic partner relationship, so evaluation of third party logistics enterprises should not limited in the current state of the enterprise, and should consider the long-term development potential.

This paper establishes the third party logistics performance evaluation index system from four aspects of financial performance, operation process, learning innovation ability and customer relationship management. As shown in table 1:

Table 1.Performance evaluation index of logistics enterprises

First order index	weight	Second order index	weight
Financial performance	0.5891	Income status	0.1783
		Operation status	0.1652
		Debt paying ability	0.0791
		Development ability	0.0625
Operation process	0.4326	Market competitiveness	0.0593
		Logistics facilities	0.0325
		Flexible strategy	0.0894
		information sharing	0.0872
Innovation ability	0.1812	learning ability	0.0462
		Innovation ability	0.0914
Customer relationship	0.1560	Service quality	0.0346
		Service attitude	0.0298
		Client Review	0.0125

3.2. Analytical Hierarchy Process

The analytic hierarchy process was put forward by the United States atty in the last century in 70s. It is a multi objective decision analysis method which combines the qualitative and quantitative analysis. The main idea is to through the analysis of the complex system of related elements and their mutual relations, simplify the ordered hierarchical structure, these elements are incorporated into different levels, in each layer establish judgment matrix, obtains the relative weights of the elements. At last, calculate the multilayer elements for the overall goal of the combination weights, for decision-making and selection provides the basis. Although our country in the middle period of the eighties of the last century began to research to the level analysis method, but its development is very rapid, multiple fields, is now in the enterprise benefit analysis, group evaluation of the comprehensive strength, energy system analysis, urban planning, economic management, scientific research evaluation has been extensive attention and application. Because the analytic hierarchy process is simple and easy to operate, and can be used to quantify the advantages of qualitative indicators, so in the third party logistics enterprises in the field of evaluation is often used, is the most common evaluation method. However, because of the combination of the analytic hierarchy process in the operation process of subjective experience, so it is inevitable that it is inevitable, the need to combine with other methods to eliminate this subjective influence. Using AHP to determine the weight of each evaluation index, under normal circumstances, according to the following steps:

(1) To establish a mathematical model with hierarchical structure, to analyze the relationship between the various factors in the evaluation index system, so as to establish the hierarchical structure of the system. That is to say, the evaluation object carries on the analytic hierarchy process, first from the target layer, then to the criterion layer, finally to the sub criterion layer, so as to determine the clear index evaluation system, and give the evaluation object factor set and sub factor set.

(2) Structure and the formation of a comparative judgment matrix, the same level of each element, based on the importance of a certain level of 22 comparison, the structure of the 22 comparison judgment matrix. By experts in the use of 1-9 ratio scale method respectively for each level of evaluation index of relative importance were the corresponding qualitative description; and accurate digital quantization representation, ultimately determine the pairwise comparison judgment matrix.

Factors set Z in each of the factors relative to the overall evaluation of the target, compared to 22, and thus the formation of the judgment matrix is as follows:

$$Z = \begin{bmatrix} 1 & Z_{12} & \cdots & Z_{1m} \\ Z_{21} & 1 & \cdots & Z_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ Z_{m1} & Z_{m1} & \cdots & 1 \end{bmatrix}$$

The judgment matrix is as follows:

$$B = \begin{bmatrix} 1 & g_{12} & \cdots & g_{1m} \\ g_{21} & 1 & \cdots & g_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ g_{m1} & g_{m2} & \cdots & 1 \end{bmatrix}$$

The relative weights of elements are calculated according to the judgment matrix, and each column of the judgment matrix is normalized;

$$\overline{z_{ij}} = \frac{z_{ij}}{\sum_{k=1}^{n} b_{kj}}$$

After each column is normalized, the judgment matrix is obtained, and then the matrix is summed up:

$$\overline{H_i} = \sum_{j=1}^{n} \overline{b_{ij}}$$

The calculation of Max according to the following formula:

$$\lambda_{max} = \sum_{i=1}^{n} \frac{(Ah)_i}{nh_i}$$

Calculate the combined weight vector, and then do a combination of consistency test. Calculate the synthesis weights of each layer of elements on the system target, and sort according to the consistency index to test the combination consistency.

$$C.I. = \frac{\lambda_{max} - n}{n-1}$$

Table 2.R.I. value of judgment matrix

1	2	3	4	5	6	7	8	9
0.00	0.00	0.57	0.82	1.14	1.31	1.40	1.42	1.47

Calculate the consistency ratio C.R.

$$C.R. = \frac{C.I.}{R.I.}$$

3.3. Performance evaluation of logistics enterprises

In order to further illustrate the practicality of AHP evaluation model, this paper selects third 8 party logistics enterprises as the research object, and collects the relevant data of the relevant performance indicators. According to the evaluation model designed in this paper, using SPSS as the calculation tool, the logistics performance of the enterprise is sorted. The third party logistics enterprise performance evaluation system is divided into four levels, then use AHP analysis to each of the two indicators for pairwise comparison, and use Yaahp software for complex data processing, finally get the following judgment matrix, as shown in Table 3.

Table 3.Judgment matrix of first order index

First order index	Financial performance	Operation process	Innovation ability	Customer relationship	weight
Financial performance	1	3	6	2	0.5285
Operation process	1/3	1	5	1/3	0.2476
Innovation ability	1/6	1/5	1	1/7	0.1513
Customer relationship	1/2	3	7	1	0.1024

The above data reflects the consistency of the judgment matrix is acceptable, and then calculated to get the weight of the first class indicators:

$$a = (a_1, a_2, a_3, a_4) = (0.5285, 0.2476, 0.1513, 0.1024)$$

The correlation matrix of each layer index can be obtained by strict standard calculation of the original data in the sample. By calculating the characteristic value of U and its corresponding orthogonal normalized vector, the number of the principal components of the model is 4, which is very clear.
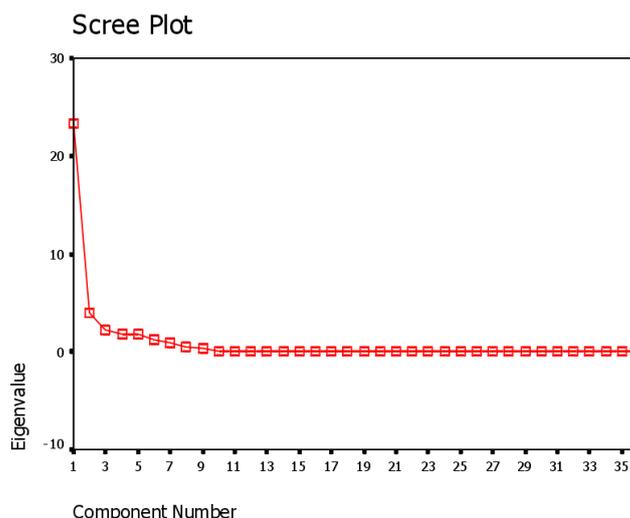
Figure 4. Scree plot

According to table 4 can be obtained by principal components could explain the total variance of the original variables situation (characteristic value, the contribution rate of variance, cumulative variance contribution rate) and the fifth column to the seventh column is the initial solution according to a certain standard extract the four principal components from the overall description of the primitive variables, they reflect the most information of the original variables.

Table 4 . Explanatory variables

compo nent	initial value			Extract value			Rotation value		
	character istic value	Varianc e contribu tion rate	Cumula tive	character istic value	Varianc e contribu tion rate	Cumula tive	character istic value	Varianc e contribu tion rate	Cumula tive
1	24.142	62.316	62.316	22.142	63.186	63.186	8.254	25.145	25.145
2	3.876	15.451	77.827	3.742	12.561	75.747	8.106	22.131	47.276
3	2.352	6.665	83.672	2.356	6.265	82.372	8.248	21.042	67.318
4	1.794	5.242	88.68	1.791	5.142	87.514	5.637	14.169	81.487
5	1.461	4.587	92.461						
6	1.146	3.325	95.867						
7	.928	2.541	97.517						
8	.764	1.328	98.845						

Through the above analysis, the different main components can highlight the same indicator information, so the simple linear addition may be too stressed that the evaluation results are not objective. Therefore, only according to the variance contribution rate of each principal component, the weight of each index class can make the result of the third party logistics enterprise performance evaluation more scientific and reasonable.

4. CONCLUSIONS

The performance evaluation of the third party logistics enterprises, through the reasonable calculation methods and models can be effective and reasonable evaluation results. Enterprise managers can accord the reasonable evaluation results for each of the key aspects of enterprise management of supervision and control, correct, complete and reasonable allocation of corporate resources, the cost minimization and maximization of profit. Therefore, for the third party logistics enterprises, should pay attention to the enterprise's own performance evaluation, timely adjust their own development direction, plan and goal. This article on the current domestic and international popular performance evaluation index system of the third party logistics enterprises to re combing, combined with the characteristics of the third party logistics enterprise business environment and enterprise itself, a relatively perfect third-party logistics enterprise performance evaluation system is established. The index system include financial performance, operation performance, customer management performance, learning and growth indicators of performance in the four aspects, financial evaluation index system and non-financial evaluation index system and the quantitative indicators and

qualitative indicators organically combined together, can comprehensively and objectively reflect the situation of production and operation of the enterprise logistics.

ACKNOWLEDGMENTS

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